[11839/32]

RACK-AND-PINION STEERING SYSTEM FOR MOTOR VEHICLES

The invention relates to a rack-and-pinion steering system for motor vehicles, whose rack is mounted in a housing such that it is longitudinally displaceable, is connected at both ends to in each case one steering rod in an articulated manner, sealing bellows being fastened on one side to the housing and on the other side to the longitudinally displaceable steering rods. Said bellows made from a flexible material serve to protect the articulated connection and the rack against dust, other solid bodies and humidity.

During driving operation, what is known as a pump effect occurs on account of the axial displacement movement of the rack, said pump effect widening the bellows as a result of the intake of air but also as a result of temperature-induced air expansion, and therefore subjecting them to an additional load. Secondly, a reduced pressure compared with atmosphere can occur in the bellows, which can lead to the annular folds bending inward. A means of compensation must be provided for the changes in volume occurring in the bellows or also within the housing.

DE 29 00 026 C3 describes a ventilation apparatus for a shaft joint having bellows sealing, which has a slotted sleeve as flow connection which is integrated between the shaft and the fastening sleeve of the bellows and allows air to pass. A disadvantage of such a solution is that, in the event of a wet roadway, water and dirt can penetrate through this opening into the joint space as a consequence of the proximity of the wheel and heavy occurrence of water spray,

and therefore the components to be protected are subjected to increased wear.

US 3,927,576 discloses an articulated connection protected by a bellows, in which this disadvantage is eliminated by integrating solids filters in the fastening collar of the bellows or in adjoining regions of, the housing, which filters, in addition to pressure compensation between the interior and atmosphere, also prevent the penetration of moisture and dirt. However, a change to the bellows is necessary here, so that specially manufactured bellows become necessary rather than the commercially available ones. The integration of the solid body filter in special ventilation openings of the housing permits subsequent installation into steering systems which are already in service only in conjunction with increased expenditure.

The invention specified in patent claim 1 is based on the problem of designing a rack-and-pinion steering system of the type specified at the outset, in which the required pressure compensation between the interior of the bellows or of the steering mechanism housing and atmosphere is ensured and, independently of the respective deployment situation and loading of the bellows, reliable sealing of the same can be achieved. The problem is solved by the feature which is specified in the characterizing part of patent claim 1, in that the pressure compensation element is integrated in the pressure piece which keeps the rack in constant engagement with the pinion.

The advantages which are achieved with the invention consist, in particular, in that the components to be protected are reliably sealed using simple means and with continuous pressure compensation, and the properties of

their translational movement remain preserved without changes to the elastic bellows or to the steering mechanism housing becoming necessary.

Advantageous developments are specified in the dependent claims.

One exemplary embodiment of the invention is shown in the drawing and explained in the following text in greater detail. In the drawing:

fig. 1 shows a diagrammatic representation of the design of an electrically assisted power steering system;

fig. 2 shows a sectional representation having a pressure compensation element integrated in a pressure piece.

Although the invention is described using a rack-and-pinion steering system 1 having electrical power assistance, it can also be used in rack-and-pinion steering systems 1 having hydraulic power assistance or without power assistance or in steering systems having external power assistance.

In a rack-and-pinion steering system 1 of this type, a pinion 9 bears an input shaft 2 which, in the exemplary embodiment according to fig. 1, is operatively connected to a steering wheel 4 via a steering column 3 provided with universal joints. Together with two steering rods 5 and 6 whose articulated connections to the rack 12 are enclosed in a protective manner by the bellows 19 and 20, the rack of the rack-and-pinion steering system 1 forms on the output element which is operatively connected to wheels (not shown) which are to be steered. Moreover, the rack 12 forms the driven part of the steering system. Using a power assisted

steering system of this type, it is possible to transmit the steering torque from the steering wheel 4 to the wheels to be steered. An assisting force can be exerted on the input shaft 2 by an electric motor 7. In this exemplary embodiment, the electric motor 7 is arranged in such a way that its axis is perpendicular with respect to the axis of the input shaft 2 and therefore of the pinion (9). However, it is also possible for its axis to be at a different angle to the axis of the input shaft 2, for example at an angle of from 60° to 130°.

With an identical or similar effect, the electric motor 7 can be arranged in such a way that its axis is arranged parallel to the axis of the input shaft 2 and therefore of the pinion 9 or parallel to the axis of another part of the steering column 3.

In the two previously described ways of arranging the electric motor 7, the latter acts on the input shaft 2 and the pinion 9 of the rack-and-pinion steering system 1. It is likewise possible for the electric motor 7 to be arranged in such a way that its axis lies parallel to, or at an angle to, or coaxially with respect to the axis of the rack 12 of the rack-and-pinion steering system 1.

In the sectional representation according to fig. 2, a pinion 9 is rotatably mounted in two bearings 10 and 11. The toothing of the pinion 9 engages with a rack 12 which is guided in the steering housing 8 in an axially displaceable manner. The rack 12 is pressed against the toothing of the pinion 9 in a known manner using a spring-loaded pressure piece 13.

The rack 12 has a longitudinal groove 16 in its toothing region on the outer circumferential surface on the opposite side from the toothing. The longitudinal groove 16 interacts with a longitudinal lug 17 which is integrally formed on the pressure piece 13. The rack 12 is prevented from tilting during operation by the interaction of the longitudinal groove 16 and the longitudinal lug 17. It is possible for these two elements to be interchanged with an identical effect, so that the longitudinal lug is arranged on the rack 12 and the longitudinal groove is arranged on the pressure piece 13

A pressure compensation element 14 designed to be air and liquid permeable is integrated in the adjusting screw 18 of the pressure piece 13 for pressure compensation in the interior of the mechanism housing 8 of the rack-and-pinion steering system 1. The adjusting screw 18, designed here as a screw cap, serves to adjust the play of the pressure piece, which play can be adjusted by the amount by which the screw cap is screwed in.

By way of example, the pressure compensation element 14 is configured as a porous sintered plastic insert which is arranged in a cutout 15 of the adjusting screw 18, said cutout 15 being adapted to the dimensions of the sintered plastic insert.

The sintered plastic insert is configured as a pressed pellet composed of PTEE material. Here, the pressed pellet is formed from ground granules which are present, for example, in the form of small balls, the granules being joined to one another under pressure and temperature. The varied density of the sintered material, which is critical

for the air permeability value, can be influenced here in a simple manner by the size and/or shape of the granules.

Here, the air permeability of the pressed pellet decreases in a manner corresponding to the magnitude of the applied pressing pressure. The property of the pressed pellet of allowing air to permeate and preventing the penetration of moisture can therefore be determined in a particularly simple manner by the granules or the pressure and the temperature of the sintering process.

The pressure compensation element 14 can also be composed of another sintered material, such as sintered bronze or another moisture tight and air permeable solids filter which can be configured as a thin disk or diaphragm.

In an application which is not shown, the entire adjusting screw 18 is composed of porous sintered material.

The introduction of a pressed pellet into the adjusting screw 18 if the pressure piece 13 makes it particularly simple to retrofit a pressure compensation element 14 to a steering mechanism 18 already in service, by exchanging the existing adjusting screw for one having a pressure compensation element 14.